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## AMENDED SPECIFICATION

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## PATENT SPECIFICATION

DRAWINGS ATTACHED

1057,855



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## COMPLETE SPECIFICATION

## A Filter including a Clogging Indicator

We, CENTRE DE RECHERCHES HYDRAULIQUES ET ELECTRIQUES, a French corporate body of 164, rue de la Croix Nivert, Paris, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a filter, particularly but not exclusively a microfilter for high-pressure liquids including a clogging indicator intended to protect appliances using the liquid from impurities which are liable to be carried along by the liquid, and which may be produced in pipes, packings, pumps and hydraulic motors.

It is known that in fine filters (where the filter pores have a diameter of less than  $10\mu$ ) the pressure drop, which is of the order of  $0.5 \text{ kg./cm}^2$  under normal operating conditions for filters at pressures of the order of  $300 \text{ kg./cm}^2$ , may rapidly increase when clogging occurs, and may reach 4 to  $5 \text{ kg./cm}^2$ .

Filter elements in such circumstances tend to deteriorate, releasing particles which were formerly retained, and endangering user appliances.

One method of protecting these appliances would reside in measuring the pressure drop across the filter, but such measurement is difficult to make with the aid of, for example manometers at very high pressures and relatively low pressure drops.

The present invention relates to a high-pressure microfilter comprising a clogging indicator sensitive to small changes of pressure which is adapted to deliver a warning signal as soon as there is a risk that a definite degree of clogging will be reached, which may con-

stitute a danger to the installation.

According to the invention, there is provided a filter comprising a filter casing having an inlet and outlet and enclosing a displaceable piston, a part of the piston being of magnetisable material and opposite faces thereof being subjected in operation to the pressures upstream and downstream respectively of a filter element when the element is positioned within the casing, means biasing the piston against the upstream pressure a member of magnetisable material disposed externally of the filter casing and mounted for movement under a biasing force relative to the casing, said member being magnetically coupled to said piston part so that said movement occurs in response to a change of position of the piston in a direction against its bias, and electrical switch means actuated in response to said movement to enable an alarm signal to be produced, said member being secured to and carried by a leaf spring secured to the filter casing and biasing said member in a direction to actuate said switch means.

One particular form of embodiment of a filter according to the invention is illustrated by way of example only in the single Figure of the appended diagrammatic drawing, and described hereinafter.

The filter illustrated comprises a filter cartridge made up of a plurality of lenticular filter elements 1 stacked up with inserted plastic packings 2 on a tubular support 3 disposed inside a hollow body 4 equipped with a union 5 for admitting liquid under pressure, which, after having passed through the filter elements 1, passes into the support 3 via holes 6, and is discharged via a union 7 in the base 8 of the hollow body 4.

The filter elements 1, which have pores of

[Price 4s. 6d.]

dimension less than 10 microns, are clamped by means of a nut 9 screwed on to the top end of the support 3 and subjected to the action of the spring 10 which bears against a cover 11 screwed into the hollow body 4. Packings 12 and 13 to provide a fluid-tight seal. The detachable cover 11 enables the filter cartridge to be replaced.

The filter elements 1 are designed to be capable of withstanding a pressure difference of several kg./cm<sup>2</sup> without any appreciable deformation.

The clogging indicator which, according to the invention is adapted to deliver a signal as soon as the pressure drop exceeds a definite value, is embodied as follows:

In the nut 9 which clamps the filter elements there is a cylinder 14 in which a piston 15, which bears against a retainer ring 16, is centred in fluid-tight fashion and can move against the action of a spring 17. The cylinder 14 communicates via a bore 18 with the central bore of the support 3. The upper face of the piston 15 is subjected to the inlet pressure P1, and the lower face to the outlet pressure P2.

The head 19 of the piston 15 is made of magnetisable material such as ferro-magnetic metal, and is separated by the upper partition of the cover 11, which is made of non-ferromagnetic metal, from an inertia block in the form of a polarised magnet 20 which is mounted for movement relative to cover 11 of body 4 by means of a leaf spring 21 carrying the magnet 20 and biasing the magnet in a direction to actuate electrical switch 22; the leaf spring is secured to the cover 11 of the body 4.

The clogging alarm operates as follows: At low losses of pressure in the filter elements 1, action on the piston 15 by liquid at inlet pressure P1 is substantially balanced by action on the piston by liquid at outlet pressure P2, and the piston is brought to bear against the retainer washer 16 by the spring 17. The attractive force exerted by the piston 15 on the polarised magnet 20 keeps the latter bearing against the upper partition of the cover 11, and the electrical switch 22 is in its inoperative position.

As soon as the pressure drop across the filter elements 1 reaches a definite predetermined value, the action of the pressure P1 on the piston 15 overcomes the combined action of the pressure P2 and the spring 17; the piston 15 moves in the direction of union 7, thus reducing the attractive force exerted on

the magnet 20, which is sufficiently free to be moved under the action of its spring 21, and which then closes the switch 22. A warning signal, such as a visual or audible signal, triggered by the switch 22 indicates that the filter has become clogged to such an extent that the filter cartridge must be cleaned.

The filter cartridge which requires cleaning may be rapidly replaced by a new cartridge or by a previously cleaned cartridge.

The microfilter in the form in which it has just been described could naturally be modified or supplemented by any useful accessory without departing from the scope of the invention.

Thus, in particular, the invention is applicable to filters using filter elements of various shapes producing a pressure-drop between the inlet pressure and the outlet pressure.

#### WHAT WE CLAIM IS:—

1. A filter comprising a filter having an inlet and outlet and enclosing a displaceable piston, a part of the piston being of magnetisable material and opposite faces thereof being subjected in operation to the pressures upstream and downstream respectively of a filter element when the element is positioned within the casing, means biasing the piston against the upstream pressure, a member of magnetisable material disposed externally of the filter casing and mounted for movement, under a biasing force, relative to the casing, said member being magnetically coupled to said piston part so that said movement occurs in response to a change of position of the piston in a direction against its bias, and electrical switch means actuated in response to said movement to enable an alarm signal to be produced, said member being secured to and carried by a leaf spring secured to the filter casing and biasing said member in a direction to actuate said switch means.

2. A filter according to claim 1 in which the filter element is provided with pores having a dimension of less than 10 microns.

3. A filter substantially as described herein with reference to the accompanying diagrammatic drawing.

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## AMENDED SPECIFICATION

*This drawing is a reproduction of  
the Original on a reduced scale*

